CLAIMS

What is claimed is:

1. A lead screw assembly, comprising:

a lead screw rotatable about a central axis and comprising:

a plurality of first threaded portions having an outer diameter and extending lengthwise of the lead screw; and

at least one second gap portion having an outer diameter that is less than the outer diameter of the first threaded portions, the second gap portion being positioned between two adjacent first threaded portions;

a reinforcing rail comprising a hollow tubular portion surrounding the lead screw and having a slot extending lengthwise of the central axis; and

at least one generally U-shaped bearing secured within the reinforcing rail and contacting the lead screw at a second gap portion.

2. The lead screw assembly of Claim 1, further comprising:

a nut assembly having a nut movable along the reinforcing rail, the nut having a tongue portion extending radially through the slot and having threads engageable with the first threaded portions of the lead screw for moving the nut in reciprocating motion lengthwise of the rail when the screw is rotated.

3. The lead screw assembly of Claim 2, wherein the nut assembly comprises an anti-backlash nut.

4. The lead screw assembly of Claim 1, wherein the reinforcing rail comprises a base portion extending from the hollow tubular portion of the reinforcing rail opposite the slot, the base portion adapted to secure the reinforcing rail to a support structure.

5. The lead screw assembly of Claim 2, wherein the hollow tubular portion of the reinforcing rail comprises a pair of side walls having splined outer surfaces, the nut assembly having internal bearing surfaces configured to made with the splined outer surfaces of the side-walls.

6. The lead screw assembly of Claim 5, wherein the ends of the lead screw are secured within the hollow tubular portion of the reinforcing rail by a pair of end bearings which surround the shaft of the lead screw, and permit the screw to be rotated within the rail.

7. The lead screw assembly of Claim 6, wherein a first end bearing includes a protrusion which fits into a slot in the hollow tubular portion of the reinforcing rail to anchor the bearing within the rail.

8. The lead screw assembly of Claim 7, wherein the slot in the hollow tubular portion extends substantially completely around the circumference of the hollow tubular portion to mechanically isolate the portion of the hollow tubular member containing the first end bearing from the portion of the hollow tubular member over which the nut assembly travels.

9. The lead screw assembly of Claim 7, wherein the second end bearing is not anchored to the reinforcing rail, and can move within the rail to accommodate relative changes in the length of the lead screw or the rail.

10. The lead screw assembly of Claim 1, further comprising means for anchoring the generally U-shaped bearing within the reinforcing rail.

11. The lead screw assembly of Claim 10, wherein the anchoring means comprises a protrusion on the generally U-shaped bearing which fits into a recess on the interior of the hollow tubular portion of the reinforcing rail.

12. The lead screw assembly of Claim 11, wherein the recess comprises a slot which runs lengthwise along the interior of the hollow tubular portion.

13. The lead screw assembly of Claim 12, wherein the generally U-shaped bearing supports the gap portion of the lead screw so as to permit stable operation of the assembly at a speed that would otherwise be in excess of the "critical speed" of the lead screw assembly.

14. The lead screw assembly of Claim 1, wherein the lead screw comprises steel.

15. The lead screw assembly of Claim 1, wherein the reinforcing rail comprises aluminum.

16. A lead screw assembly, comprising:

a threaded lead screw rotatable about a central axis;

a reinforcing rail, comprising:

a hollow tubular portion surrounding the lead screw and having a slot extending lengthwise of the central axis; and

a base portion extending from the hollow tubular portion opposite the slot, the base portion adapted to secure the reinforcing rail to a support structure; and

a nut assembly having a nut movable along the hollow tubular portion of the reinforcing rail, the nut having a tongue portion extending radially through the slot and having threads engageable with the first threaded portions of the lead screw for moving the nut in reciprocating motion lengthwise of the rail when the screw is rotated.

17. The lead screw assembly of Claim 16, wherein the hollow tubular portion of the reinforcing rail comprises a pair of side walls having splined outer surfaces, the nut assembly having internal bearing surfaces configured to made with the splined outer surfaces of the side-walls.

18. The lead screw assembly of Claim 17, wherein the nut assembly extends substantially around the outer circumference of the hollow tubular portion, but not around the base portion of the reinforcing rail.

19. The lead screw assembly of Claim 16, wherein the base portion comprises at least one flat surface extending at least partially along the length of the rail for securing the rail to a support structure.

20. An anti-backlash nut assembly, comprising:

a nut body having a central cavity for engagement with a reinforcing rail, the nut body comprising:

a follower within the nut body and having a tongue portion extending into the central cavity, the tongue portion having threads for engagement with a threaded lead screw rotatable within the reinforcing rail, the follower having first and second sloping surfaces at opposite ends of the follower;

a first wedge within the nut body, the first wedge having a sloping surface for engagement with the first sloping surface of the follower; and

a second wedge within the nut body, the second wedge having a sloping surface for engagement with the second sloping surface of the follower.

21. The anti-backlash nut assembly of Claim 20, wherein the first wedge and the second wedge are preloaded against the sloping surfaces of the follower to force the threads of the tongue portion into forcible engagement with mating threads of a lead screw.

22. The anti-backlash nut assembly of Claim 21, wherein the amount of pre-load between the wedges and the follower is adjustable to vary the level of backlash-resistance of the assembly.

23. The anti-backlash nut assembly of Claim 20, further comprising a spring member within the nut body, the spring member configured to apply an adjustable bias force to the first wedge.

24. The anti-backlash nut assembly of Claim 20, further comprising a pair of set screws within the nut body, the set screws configured to adjust the relative positions of the wedges within the nut body.

25. The anti-backlash nut assembly of Claim 20, further comprising a cap which encloses the follower, the first wedge, and the second wedge within the nut body.

26. The anti-backlash nut assembly of Claim 20, wherein the nut body comprises a generally oval-shaped opening extending from a first surface of the nut body to the central cavity, the follower, the first wedge, and the second wedge being housed within the generally-oval shaped opening.

27. The anti-backlash nut assembly of Claim 26, further comprising a U-stop at a first end of the generally oval-shaped opening and extending partially around the interior of the generally oval-shaped opening.

28. The anti-backlash nut assembly of Claim 27, wherein the first wedge is positioned at a second end of the generally oval-shaped opening, opposite the U-stop, and the second wedge is positioned within the generally oval-shaped opening between the U-stop and the follower.

29. The anti-backlash nut assembly of Claim 28, further comprising:

a first set screw within the nut body, the first set screw configured to adjust the position of the first wedge; and

a second set screw within the nut body, the second set screw configured to adjust the position of the second wedge.

30. The anti-backlash nut assembly of Claim 29, further comprising a spring member within the nut body, the spring member being positioned between the first set screw and the first wedge.

31. The anti-backlash nut assembly of Claim 30, wherein spring member is adapted to bias the first wedge against either the follower or the U-stop to provide variable levels of backlash resistance and wear compensation.

32. The anti-backlash nut assembly of Claim 30, wherein the spring member comprises an elastomeric material.

33. The anti-backlash nut assembly of Claim 20, wherein the angle of the first sloping surface of the follower and the angle of the sloping surface of the first wedge are supplementary.

34. The anti-backlash nut assembly of Claim 20, wherein the angle of the second sloping surface of the follower and the angle of the sloping surface of the second wedge are supplementary.

35. The anti-backlash nut assembly of Claim 20, wherein the angles of interface between the sloped surfaces of the follower and the wedges are selected have approximately the same angle of interface as between the flanks of the threads on the lead screw and the follower.

36. The anti-backlash nut assembly of Claim 28, wherein the wedge members are configured to bias the follower against a side surface of the generally oval-shaped opening to further minimize backlash between the threads of the follower and the threads of a lead screw.

37. A lead screw assembly comprising a screw with lengthwise extending threaded portions alternating with gap portions, the screw supported by a rail having bearings contacting the gap portions.

38. A lead screw assembly, comprising:

a threaded lead screw rotatable about a central axis;

a reinforcing rail surrounding the lead screw;

a nut assembly comprising means for moving the nut in reciprocating motion lengthwise of the rail when the screw is rotated; and

means for supporting the lead screw at a plurality of spaced-apart locations along the length of the reinforcing rail.

39. A nut comprising a threaded follower biased in a radial direction by wedges into engagement with the threads of a lead screw.

40. An adjustable anti-backlash nut assembly, comprising:

a follower having a threaded surface for engagement with a lead screw;

means for biasing the follower in a radial direction to force the threaded surface of the follower into forcible engagement with mating threads of the lead screw;

means for adjusting the bias force against the follower to adjust the backlash-resistance of the nut assembly; and

means for maintaining the backlash-resistance of the nut assembly substantially at a pre-determined level as the threads of the follower wear during use.

41. A method for bilateral translation of a nut assembly, comprising:

providing a lead screw having a plurality of first threaded portions having an outer diameter and extending lengthwise of the lead screw, and at least one second gap portion having an outer diameter that is less than the outer diameter of the first threaded portions, the second gap portion being positioned between two adjacent first threaded portions;

providing a reinforcing rail comprising a hollow tubular portion surrounding the lead screw and having a slot extending lengthwise of the central axis;

securing the second gap portion of the lead screw to the reinforcing rail with a generally U-shaped bearing;

providing a nut assembly having a nut movable along the reinforcing rail, and a threaded portion engageable with the threads of the lead screw; and

rotating the lead screw within the reinforcing rail to cause the nut assembly to move along the reinforcing rail.

42. The method of Claim 41, wherein the generally U-shaped bearing supports the gap portion of the lead screw in such a manner as to permit the lead screw to be rotated at a speed that would be in excess of the "critical speed" of the lead screw assembly if the generally U-shaped bearing was not present.

43. A method of operating an anti-backlash nut assembly, comprising:

providing a nut assembly comprising a follower with first and second sloping surfaces at opposite ends of the follower and a threaded surface for engagement with a lead screw, a first wedge having a sloping surface contacting the first sloping surface of the follower, and a second wedge having a sloping surface contacting the second sloping surface of the follower; and

pre-loading the first wedge and the second wedge against the sloping surfaces of the follower to force the threaded surface of the follower into forcible engagement with mating threads of the lead screw.

44. The method of Claim 43, comprising:

adjusting the relative positions of the first wedge and the second wedge within the nut assembly to vary the pre-load forces of the wedges against the follower, thereby adjusting the degree of backlash resistance of the nut assembly.

45. The method of Claim 44, wherein the relative positions of the first wedge and the second wedge are adjusted by adjusting the positions of first and second set screws within the nut assembly which engage the first wedge and the second wedge, respectively.

46. The method of Claim 45, wherein an elastic member is disposed between a first set screw and the first wedge.

47. The method of Claim 46, further comprising adjusting the position of the first set screw to adjust a bias force applied by the elastic member to the first wedge, thereby adjusting the degree of wear compensation of the nut assembly.